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(54) IMPROVEMENTS IN FLUID-COOLED FUEL INJECTION NOZZLES FOR  
 INTERNAL COMBUSTION ENGINES

(71) We, ROBERT BOSCH G.m.b.H., a German Company, of Postfach 50, 7 Stuttgart 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a fuel injection nozzle for internal combustion engines, having a cooling sleeve, which is fitted on the nozzle body and serves for the circulation of cooling fluid about said body.

In various internal combustion engines special demands give rise to extremely high temperatures, which may lead to the fuel injection nozzle being ruined. This is particularly true of slow-running internal combustion engines in whose operation viscous heavy oil is generally used. So as to enable this viscous oil even to be conveyed by the injection system, said oil must be preheated. The combination of the heat from the preheated oil and the heat arising from the combustion process causes the permissible temperature at the fuel injection nozzle to be exceeded. The hardness at the needle seat of the fuel injection nozzle is thereby reduced, this seat becomes carbonized and the service life of the fuel injection nozzle is decreased. Furthermore, from a certain temperature onwards the fuel begins to crack, thereby causing deterioration in the combustion in the internal combustion engine.

Other internal combustion engines are supercharged to achieve a specific increase in output power, i.e. the air is forced into the combustion chamber of the internal combustion engine. Increases in specific power give rise to correspondingly higher temperatures in the combustion chamber of the internal combustion engine, which may lead to the fuel injection nozzle becoming overheated. In this case the same symptoms are produced as have already been described for the slow-running internal combustion engines.

Such cases of overheating of the fuel injection nozzle are to be eliminated by

means of a cooling chamber through which cooling fluid flows. This can be effected by mounting a cooling sleeve over the nozzle body.

In known cooled fuel injection nozzles a cooling sleeve is connected to the nozzle body by welding, shrink fitting or rolling in. However, these types of connection are accompanied by various disadvantages. In the case of the welded cooling sleeve, a relatively large amount of waste is produced as a result of the hot processing during production. In the case of shrink fitting and rolling in, leaks may be produced, which no measures have been able to prevent, particularly at the sealing point adjacent the injection aperture in the tip of the nozzle body.

A feature of the invention is to provide a fuel injection nozzle in which a fluid-tight connection is provided between the cooling sleeve and the nozzle body and in the course of whose production there is not too large an amount of waste.

In accordance with the invention, there is provided a fluid-cooled fuel injection nozzle for an internal combustion engine, having a cooling sleeve which is fitted on the body of the nozzle and is sealed thereto at axially spaced apart places on the sleeve to form a fluid-tight coolant chamber between the sleeve and the nozzle body; the sleeve, at at least one of said places, being a shrink fit on the nozzle body and being fitted on the nozzle body with a resilient sealing ring so that the sealing ring lies between and in engagement with the sleeve and the nozzle body.

The advantage as compared with the known injection nozzles lie in the use of a combination of a shrink fit and a sealing ring. Whilst hot processing of the nozzle body and cooling sleeve are necessary in the case of the known fluid-tight welded connections, this process and the attendant difficulties are eliminated in the present invention. In the case of the injection nozzles in which the coolant sleeves have only been shrunk fitted or pressed on, uncontrollable

leaks are produced, but this is avoided in the fuel injection nozzle of the present invention.

In accordance with an advantageous embodiment of the invention the cooling sleeve has an axially inwardly directed annular portion at its end adjacent the injection aperture, which is sealed to the nozzle body and the inner annular end face of which sealingly engages the sealing ring. This affords the special advantage of the sealing ring being set back in a cooler zone, thus, together with the shrink fit ensuring a fluid-tight connection.

On its end remote from the injection aperture, the cooling sleeve may be press fitted on the nozzle body and may have a portion with an enlarged diameter with a shoulder which is formed thereby, and a sealing ring can be disposed in an annular groove in the nozzle body to engage the inner surface of the enlarged diameter portion of the sleeve. In this case the press fit and the sealing ring together form a fluid-tight connection.

In accordance with another embodiment of the invention, the cooling sleeve has, on its end remote from the injection aperture, a radial thickening which in assembling the sleeve with the nozzle body is rolled into an annular groove in the nozzle body.

The invention is further described, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a longitudinal section of a first embodiment of a nozzle body having a fitted cooling sleeve and two sealing rings, and

Fig. 2 is a similar view of a second embodiment of a nozzle body having a fitted cooling sleeve and a sealing ring.

In the embodiment of fuel injection nozzle shown in Fig. 1, a cooling sleeve 2 is fitted on the nozzle body to seat against annular surfaces 3, 4, 5 formed on the nozzle body. A coolant chamber 6 is thereby defined between the nozzle body 1 and the cooling sleeve 2. Adjacent to the annular surface 3, the cooling sleeve 2 has an axially inwardly directed portion provided with an annular end face 7 which faces axially inwardly of the coolant chamber. A resilient sealing ring 9 is located between this end face 7 of the cooling sleeve 2 and a shoulder 8 on the nozzle body 1. At this place, the sealing ring 9 and the fit on the annular surface 3 form a fluid-tight connection. On its end remote from the injection aperture (not shown) in the tip of the nozzle body 1, the cooling sleeve 2 has an enlarged diameter portion 10, thereby defining a mounting shoulder 11 which a nut (not shown) engages to clamp the nozzle to a nozzle holder (also not shown). An annular groove 12 in the annular surface 5 accommodates a resilient sealing ring 13, so

as thereby to provide a fluid-tight connection at this place also. The cooling sleeve 2 is shrunk fitted on to the nozzle body 1, at least the cylindrical surface 3.

In the case of the nozzle shown in Fig. 2, parts which correspond to those of Fig. 1 are provided with the same reference numerals which are, however, furnished with a prime. In the case of the nozzle body 1<sup>1</sup> the cooling sleeve 2<sup>1</sup> is pressed against the annular surfaces 3<sup>1</sup>, 4<sup>1</sup>; the sleeve being shrink fitted against the annular surface 3<sup>1</sup>. At its end remote from the injection aperture in the tip of the nozzle body 1<sup>1</sup>, the cooling sleeve 2<sup>1</sup> has a thickening 14. In assembly the thickening 14, which is shown as a dotted line, is rolled into an annular groove 15. A fluid-tight connection is thus produced by means of the tight fit at the annular surface 4<sup>1</sup> and at the end portion of the sleeve which has been rolled into the annular groove 15.

#### WHAT WE CLAIM IS:—

1. A fluid-cooled fuel injection nozzle for an internal combustion engine, having a cooling sleeve which is fitted on the body of the nozzle and is sealed thereto at axially spaced apart places on the sleeve to form a fluid-tight coolant chamber between the sleeve and the nozzle body; the sleeve, at at least one of said places, being a shrink fit on the nozzle body and being fitted on the nozzle body with a resilient sealing ring so that the sealing ring lies between and in engagement with the sleeve and the nozzle body.

2. A fluid-cooled fuel injection nozzle as claimed in claim 1, in which said one place of the cooling sleeve is formed by an axially inwardly directed annular portion of the sleeve at its end adjacent the injection aperture, which is sealed to the nozzle body so that an inner annular end face of said annular portion sealingly engages said sealing ring.

3. A fluid-cooled fuel injection nozzle as claimed in claim 1 or 2, in which the end of the cooling sleeve remote from the injection aperture has a portion with an enlarged diameter with a shoulder which is formed thereby, and in which a sealing ring is disposed in an annular groove in the nozzle body to engage the inner surface of the enlarged diameter portion of the sleeve.

4. A fluid cooled fuel injection nozzle as claimed in claim 1 or 2, in which the end of the cooling sleeve remote from the injection aperture has been rolled into an annular groove in the nozzle body.

5. A fluid cooled fuel injection nozzle as claimed in claim 4, in which the cooling sleeve has a radial thickening on its end facing away from the injection aperture

which thickening has been rolled into the annular groove in the nozzle body.

5 6. A fluid cooled fuel injection nozzle, constructed substantially as herein described with reference to and as illustrated in Fig. 1 of the accompanying drawings.

7. A fluid cooled fuel injection nozzle, constructed substantially as herein described

with reference to and as illustrated in Fig. 2 of the accompanying drawings.

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Fig 1

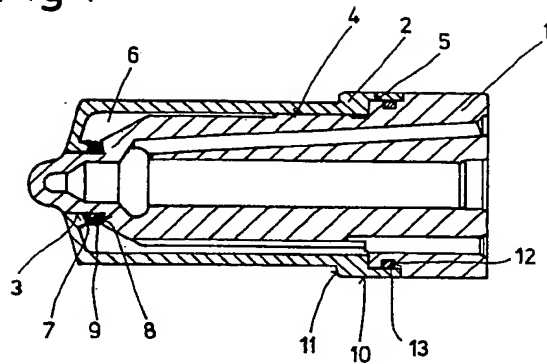


Fig 2

